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As device features in next generation integrated circuits (IC) continue to shrink metal interconnection time delays limit chip performance and reliability by increasing power dissipation and cross-talk. As a result the semiconductor industry is migrating to the use of Cu as a low resistance metalization, and typically using a barrier metal like TaN to limit diffusion of Cu into the dielectric and improve adhesion. A low dielectric constant (k) material needs to be identified, which must have good thermal stability (above 400 °C), low coefficient of thermal expansion (CTE), low moisture uptake, high glass transition temperature (T_g), strong mechanical properties, high electric breakdown field, good thermal conductivity and good adhesion to various substrates.

In this work we are investigation the diffusion of Cu deposited on various thicknesses of TaN on a new class of porous, low-k dielectrics. A series of triblock polymers, poly(ethylene oxide-b-propylene oxide-b-ethylene oxide) (PEO-b-PPO-b-PEO), are used as sacrificial materials in poly(methyl silsesquioxane) (MSQ) to generate pores in the MSQ matrices when heated above 400 degree C. Dielectric constants equal to or less than 2.0 have been achieved with high dielectric breakdown strength (> 2 MV/cm) when more than 30 wt% loading of triblock polymers.

The specimens consisting of 1000 Å of Cu deposited on either 150 Å or 300 Å of TaN on dielectric substrates of porosity varying from 0 to 50 volume% have been heated to temperatures as high as 500°C. After the annealing took place, the Cu was chemically stripped and the samples were examined with x-ray photoelectron spectroscopy, x-ray fluorescence, and SIMS. These results put upper limits on the porosity, thermal budget, and thickness of the barrier layer. The effects of porosity on mechanical strength and the mechanism